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# A TREATISE

ON

# POSITIVE PRINTING.

BY

THOMAS SUTTON, B.A.

LONDON:
LAMPRAY, TIBBITTS & Co., 44, PATERNOSTER ROW.

**One Shilling.**

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BEING

## A FULL DESCRIPTION OF THE MODE OF USING THE NEW PATENT ALBUMENIZED PAPER.

BY

THOMAS SUTTON, B.A.

Author of "The Collodion Processes, Wet and Dry,"
a "Dictionary of Photography," &c.;
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# PREFACE.

The present pamphlet has been written chiefly as a guide to those who use my patent albumenized paper, which is sized with India-rubber before applying the albumen. But altho' the process described is particularly suitable for that paper, yet it will be found equally well adapted for the common paper, and calculated to yield the best prints. It is a process at which I have arrived after many years of experimenting, and I strongly recommend it to the notice of photographers as the best printing process for card portraits and stereoscopic views.

Although I have laid great stress on the advantages of the calcio-chloride of gold as a toning bath, yet those who succeed upon common paper with any other bath will be equally sure to succeed with the same bath upon the patent paper.

Since the body of the work has been printed, I have disposed of the patent to Mr. Lampray, of Paternoster Row. It becomes necessary for me therefore to inform the reader that as I have no longer any control over the patent, I cannot grant him a permissive right to prepare his own paper with India-rubber, according to the directions contained in the second chapter. The

portion of that chapter which relates to the process of coating the paper with India-rubber must only be considered as conveying the information with which every patentee is bound to supply the public in return for the temporary monopoly which is granted to him.

I shall be happy to answer any queries through the medium of my fornightly Journal, *Photographic Notes*.

T. S.

St. Brelade, Jersey,
March, 1863.

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# CHAPTER I.

## HISTORY OF POSITIVE PRINTING WITH THE SALTS OF SILVER.

Charles William Scheele, of Stralsund, in Pomerania, published in 1777 the fact that chloride of silver is darkened by exposure to the sun's rays. His experiment consisted in precipitating chloride of silver from a solution of nitrate of silver by chloride of ammonium, and exposing the precipitate to light. The darkened mass was then digested in ammonia, which dissolved out all the unreduced chloride of silver, but had no effect upon the black powder. This black powder was afterwards dissolved in nitric acid, and chloride of ammonium added to the solution; this threw down white chloride of silver. Another experiment consisted in exposing chloride of silver to light under water in a bottle. After the chloride had become black the water was dropped into a solution of nitrate of silver, from which it immediately precipitated chloride of silver.

These facts are the basis of Positive Printing, and Scheele *might* have become the discoverer of photography upon paper, if he had simply applied his knowledge of

the properties of chloride of silver in the following way:—Dip a sheet of paper in a solution of chloride of ammonium, dry it, float it upon a solution of nitrate of silver, expose it under a piece of lace, or painted glass, until the exposed parts have sufficiently blackened in the light, and then remove the unaltered chloride of silver by steeping the paper in ammonia. Positive prints taken by Scheele in this way would probably have remained permanent to this day.

Another important experiment of Scheele's consisted in fixing a glass prism in the window, and placing a piece of paper, covered with chloride of silver, in the spectrum produced by refracting the sun's rays through the prism. He found that the chloride of silver blackened sooner in the violet than in any of the other rays.

Scheele also found, by pouring a solution of nitrate of silver upon chalk, that the carbonate of silver thus formed darkened in the light.

In 1802, Thomas Wedgwood, son of the celebrated manufacturer of the Wedgwood ware, made a movement towards the discovery of photography upon paper; but instead of applying the facts published by Scheele nearly thirty years before, he at first ignored the properties of chloride of silver, and exposed to light sheets of paper, or leather, dipped in a solution of nitrate of silver. The parts exposed darkened slowly under pieces of lace and stained glass, and in this way positive prints were produced; for which, however, no means of

what is called "fixing" were applied. These sheets of paper probably contained chlorine, and the leather tannic acid, which made them more sensitive. Thus Mr. Wedgwood was, after a fashion, the first photographic printer, but his prints could only be viewed by candle light, or yellow light, because the material which was sensitive to white light was not removed from the paper. Sir Humphrey Davy, about this time, made some similar experiments to those of Mr. Wedgwood, and added some comments of his own to the paper in which the experiments of Mr. Wedgwood were published.

We have now to take another stride of more than thirty years, which brings us to the discoveries of the Rev. J. B. Reade, the Hon. Fox Talbot, and Sir John Herschel. What was chiefly wanted was a suitable solvent for removing the unaltered chloride of silver from the photographic tablet upon which it was spread. Scheele had found that ammonia would do this, but the fact was strangely overlooked. Sir John Herschel discovered the important use of hyposulphite of soda for this purpose, and by that discovery the art of photographic printing upon paper was rendered complete. In January, 1839, the Hon. Fox Talbot, having availed himself of the labours of those whose names have been recorded, published in a paper, read before the Royal Society, the practical details of a process of photographic printing upon paper, in which however the fixing process was left in an imperfect state. In April, 1839, Mr. Brayley exhibited at a *Soirée* at the

London Institution, some photographic pictures by the Rev. J. B. Reade, which had been printed upon paper prepared with nitrate of silver, and to which had been applied, when dry, some solution of gallic acid, in order to render them more sensitive. These prints were fixed with hyposulphite of soda. The idea of using gallic acid in this way arose from observing the fact that pieces of leather soaked in nitrate of silver were more sensitive to light than sheets of paper treated in the same way.

The above experiments by Mr. Talbot and Mr. Reade were published in the spring of 1839, and it was not until July of that year that the process of Daguerre, upon silver plates, was made public. The camera images copied at that time by photography required an extremely long exposure, both upon chloride of silver papers, and iodized silver plates. But we are not concerned here with the history of camera operations, but with that of Positive Printing.

In 1841 the Hon. Fox Talbot patented a method of developing negatives upon paper by the use of iodide of silver and gallic acid, and papers thus prepared were sufficiently sensitive for taking camera pictures with a few minutes exposure. The same process could be employed for positive printing upon paper, and for that purpose only one or two seconds exposure to light under a negative were required. The process consisted in first preparing the paper with nitrate of silver, and then with iodide of potassium; after which it was rendered

sensitive to light by being washed over with a mixed solution of gallic acid and nitrate of silver. The latent image obtained by exposure to light was then developed with gallo-nitrate of silver; and the iodide of silver removed from the paper by hyposulphite of soda. This process is rarely used now for printing positives, a better one, in which the order of the first two operations is reversed, having been substituted for it by M. Blanquart-Evrard, about five years afterwards; as will be described presently. The use of iodide instead of chloride of silver in Mr. Talbot's negative process was no doubt suggested by its employment in the process of Daguerre. The discovery of the mode of developing latent images upon paper by means of gallic acid is due to an accidental experiment by one of the early photographers, between the years 1839 and 1841, in which an under-printed positive upon leather was put aside as worthless, and found some hours afterwards to have acquired great additional intensity.

We have now traced the early history of Positive Printing, both by the methods of continued exposure to light, (called "Sun-Printing"), and by the development of a latent image, (called "Development-Printing"). But the prints obtained by these early processes were inartistic in effect and colour, and it remained to improve them in these respects by methods which will be explained as we proceed.

There is a great analogy between the Daguerreotype and paper processes, and the results of both were at

first inartistic in effect. Daguerreotypes were grey and flat, with sombre lights, and shadows devoid of intensity. Sun prints were flat, devoid of vigour, and of an ugly rusty-red colour; and developed prints mealy, sunk in the paper, and of an ugly olive colour. The early prints published by Mr. Talbot, in a work entitled the "Pencil of Nature" exhibit these defects. In addition to the above faults of Daguerreotype pictures, the image existed as a sort of powder upon the plate, which could be removed by the touch, and it was in correcting this defect that a method of toning the impression and improving the effect were at the same time discovered. It was about the year 1845 that M. Fizeau discovered the use of gold for fixing and toning Daguerreotypes, and a similar process was used some years afterwards for improving and intensifying the colour of positive prints. M. Fizeau used a solution of chloride of gold added in certain proportion to one of hyposulphite of soda; and the same compound was afterwards found to deepen the tone of positive prints.

A year after M. Fizeau's discovery of the use of gold in the Daguerreotype, M. Blanquart-Evrard, a physician at Lille, who had married the daughter of a wealthy cloth manufacturer in that city, and given up his profession, turned his attention to the new art of photography upon paper, and contributed more than anyone else to give it commercial and artistic importance. His first experiments resulted in reversing the first two operations of Mr. Talbot's negative process, and he applied to the paper first the iodide of potassium and

then the nitrate of silver; thus establishing the proper order in which these operations should be performed, and which is now universally adopted in the Collodion process. He also coated the paper with iodized serum of milk, and also with iodized albumen; and having thus greatly improved the negative paper process, he turned his attention to rendering positive prints more artistic and presentable. In this respect he was so eminently successful that in 1851 he commenced the publication of the "Album Photographique de l'Artiste et de l'Amateur," a work issued monthly, and every number of which contained four prints, not less than 8 × 6, handsomely mounted, with engraved titles and gold borders, and sold at the very low price of 5 francs. These prints were produced with wonderful uniformity, and nothing has since been done in photography upon plain paper to surpass them in artistic beauty of colour, and in permanency. The process was for many years kept a commercial secret, and was never published until I discovered a process very like it by independent experiments, and described it in my pamphlet on printing in the year 1855. The prints were developed with gallic acid, upon papers prepared by the reversed process described, and either toned with gold, or by exposure for some weeks to light under glass, according to the tint desired. But it is not within the province of the present work to say more on the subject of developed prints. We are chiefly concerned here with the history of Sun-Printing by continued exposure to light.

Returning to the labours of M. Blanquart-Evrard. He was the first to discover and publish the use of sulphur as a toning agent; and the use of a hyposulphite bath from which free sulphur is liberated by the addition of acetic acid was recommended by him in a treatise on photography upon paper, which he published in 1850. This work was however scarcely in circulation before he discovered that prints toned in such a bath almost invariably fade; he therefore immediately discontinued and discouraged the use of this toning bath; but for a number of years other photographers unfortunately adopted it, to the great discredit of the photographs they sent out.

Another toning bath for improving the appearance of positive prints, and at the same time fixing them by removing the chloride of silver, was introduced about this time by M. Gustave Le Gray. He published the process in a small pamphlet, which was translated into English by Messrs. Knight, of Foster Lane. This fixing and toning bath was made by adding a weak solution of chloride of gold to a strong solution of hyposulphite of soda. The print when immersed in this bath took at first the usual ugly red colour, but by leaving it for some hours in the bath the colour changed to a deep brown or purple-black. The same bath was used again and again until it became quite black, and the prints were frequently put into it without having the free nitrate of silver previously removed from them by washing. This bath toned the prints partly by sulphuration, and partly by the substitution of gold for silver;

its sulphurating action being derived in the first instance from the addition of acid chloride of gold to the hyposulphite solution. The general employment of this bath was attended for many years with the most disastrous effects, because nearly every print that was toned in it faded; and unless some better method of toning had been devised photography upon paper must by this time have become nearly extinct as a useful art, or an art of commercial interest and value.

But in thus tracing to this unsatisfactory point the history of photographic printing upon paper, I have overlooked the introduction of the use of albumen as a means of giving vigour and brilliancy to a print, and transparency to the shadows. M. Niepce de St. Victor was the first to use albumen in photography, and in 1848 he applied it to glass plates, and took negatives upon albumenized plates in the camera. The use of albumen does not appear to have affected the permanency of prints, for those which were printed upon plain paper and toned in the sulphurating hypo bath faded just as badly as those which were printed upon albumenized paper and toned in the same way.

Let us now recall to mind what has been said.

First with respect to Sun-prints. When these are simply fixed with hyposulphite of soda, or ammonia, they exhibit an extremely disagreeable rusty-red colour, which renders them unpresentable as pleasing pictures. But although in this state the prints are undoubtedly permanent, it was absolutely necessary to change their

disagreeable colour in some way. The method employed, and generally adopted for some years, for this purpose entirely failed, because it caused the prints to fade.

Next, with respect to Developed prints. When these are printed, not by the original process of Mr. Talbot, but by the reversed process of Blanquart-Evrard, the colour is good in the first instance and no toning is required. These prints are not only very beautiful but for the most part permanent, particularly when developed upon iodide of silver. Dr. Diamond, who has had perhaps more experience than anyone in taking Calotype negatives, publicly stated very lately that he had never known one of these negatives fade. On this subject a great deal might be said, but it would be out of place here. Should it be asked why Printing by Development has not been generally adopted, the answer is that people like albumenized paper, and this is not suitable for developed prints because it yields a disagreeable olive colour. A positive print must be good in colour, as well as vigorous in effect, or it is next to worthless for trade purposes.

We now come to the improved toning process for sun-prints upon albumenized paper, employed at the present day, and which not only yields the most beautiful prints but appears to be right in principle, as proved both by theory and practice, for very little is now heard of the fading of prints; that is an evil which has very nearly passed away. The probable duration of a properly toned silver print may now be estimated by

years instead of by months or weeks as before. Still, however, certain precautions must be taken in the manipulation, in order to ensure permanancy, as will be described bye and bye.

The present improved process of toning consists in using for this purpose a DOUBLE salt of gold before fixing the print in hyposulphite of soda. The toning and fixing baths are therefore independent. The former changes the rusty colour by substituting purple gold for red silver in the shadows of the print; and the latter does not tone by sulphuration, but merely removes the unaltered chloride of silver.

The first published process of toning with gold, before fixing, is due to M. Le Gray, who, in a second edition of the pamphlet before alluded to, described in an Appendix a method of toning in which the proof was first printed so deeply as to be nearly blackened and bronzed all over, and then cleared up and toned by immersion in a solution of chloride of gold rendered acid by the addition of hydrochloric acid; after which it was fixed in a fresh solution of hyposulphite of soda. No reason was assigned for using *acid* chloride of gold, and photographers of the present day know that this toning process of Le Gray's was wrong in principle; the right method being to use a *double* salt of gold instead of the bleaching and destructive *acid* chloride recommended by him.

In tracing the history of the introduction of the method of toning employed at the present day, which consists in the use of a *double* salt of gold before fixing,

we now come to the Sel-d'or process, published by me in the Number of the "Photographic Journal," for March, 1855. The publication of this process established a new principle of toning, and paved the way to the use of those double salts of gold which have now been substituted for sel-d'or; those salts being either calcio, or sodio-chloride of gold, whilst sel-d'or is a double hyposulphite of gold and soda. These double salts of gold all act on exactly the same principle, by withdrawing an atom of silver from the print and substituting for it an atom of gold; and thus the colour of the print is changed from red to purple before it goes into the fixing bath.

In using sel-d'or for the toning bath, the positive is printed a shade deeper than it is intended to be when finished; the whole of the free nitrate of silver in the paper is then removed by first washing it with water, and then with salt and water; and the print is then placed in a weak solution of sel-d'or, in which the shadows assume by degrees a purple tint, whilst the lights remain white. When sufficiently toned it is washed, and placed in a fresh solution of hyposulphite of soda, which removes the unaltered chloride of silver; and after another washing the operation is complete. Such is the Sel-d'or process, published by me in 1855. The objection to it is, that unless the whole of the free nitrate is removed from the paper a yellow precipitate of metallic gold is thrown down upon the lights of the picture. The same precipitate is produced by adding solution of sel-d'or to nitrate of silver, and as this precipitate is more soluble in *aqua-regia* than sulphur is, it is

proved not to be sulphur, as some persons have supposed. It has not the colour of sulphur, and it is surprising that any one should have mistaken it for sulphur. Every print which I have toned with sel-d'or, and preserved in my own portfolio, has remained permanent to this day; and in the Album belonging to the photographic department of King's College are a number of experimental prints by Mr. Hardwich, toned with sel-d'or, not one of which has faded.

It is but a short step from my sel-d'or process of toning to those now in use, in which a double chloride of gold and sodium, or calcium, have been substituted for sel-d'or. The advantage of the Calcio-chloride is that it does not injure the whites of the print, even supposing that the whole of the free nitrate has not been removed, for then it simply converts it into chloride of silver and throws it down as a white precipitate in the toning bath. It is also less liable to adulteration than sel-d'or. The mode of using all the double chlorides is exactly the same. Of all those which can be formed of gold and an alkaline or earthy metal, by far the best appears to me to be that which I have introduced lately, and strongly recommend in the present work, viz., the calcio-chloride of gold. The solution of this salt, with the addition of a small quantity of chloride of lime to neutralize the effects of free nitrate of silver in the albumen of the print, is permanent and always ready for use. It is as colorless as water, and does not bleach the prints; and is always ready for use,

only requiring from time to time to be strengthened with a little fresh solution.

I have now briefly sketched the history of Positive Printing up to the present time, and indicated the successive steps by which the art has reached its present satisfactory state. I have experimented much at it myself, and it has been with me for ten years a favourite branch of photography, because I felt that the existence of photography upon paper as a useful art and profitable occupation depends chiefly upon the production of beautiful and permanent prints. For small pictures, such as card portraits and stereoscopic views, the process upon albumenized paper described in this work is the very thing wanted, and it is difficult to imagine anything better. In these small pictures there is no objection to a glazed surface, and a great merit in the fine definition and transparency in the shadows which albumen gives. But for large pictures of a bolder class plain paper is, according to my taste, much more suitable, and here the development process comes in very happily, and yields the finest results.

Nearly a hundred years have thus elapsed since Scheele first published his experiments with chloride of silver exposed to light, and ammonia as a solvent of the unaltered chloride. The application of these facts would at once have conducted him to photography upon paper, but that step was not taken until sixty years afterwards; and then came the trouble of toning, which it took another fifteen years to solve satisfactorily. Let there-

fore those who have contributed their mite of useful labour towards the advancement of this new art, instead of glorying in what they have done, reflect with humility upon the slow progress which has been made in it, as compared with the large amount of time and material which they have spent in experiment, and wasted in failures. When an experimental problem of this kind has once been solved how simple it appears, but while it is in process of solution how difficult that solution always seems to be.

Thus much for the chemical difficulties of printing, but there still remained to be overcome anothor trouble due to variations in the quality of the paper employed, and the trade secrets involved in its manufacture. While experimenting lately in another direction with a solution of India-rubber in benzole, I found that this solution rendered blotting-paper impervious to water, and it immediately occurred to me that by sizing photographic or other paper with this solution the albumen would lie more upon the surface, and yield more brilliant prints. Experiment proved that this conjecture was correct. I have patented the process, and photographers are no longer so dependent upon the paper maker as before, for let him size the paper as he may a fine glossy surface of albumen can still be obtained upon it. The use of this solution of India rubber, in the manner described in my patent, renders the operations of the photographic printer more uniform and certain than they have hitherto been, besides improving the prints in brilliancy and permanency. It only

wanted this last finishing touch to render the printing of positives as certain as any other mechanical art, and the following pages are devoted to a minute description of the Printing process in its present improved state.

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## CHAPTER II.

### OUTLINE OF THE OPERATIONS TO BE PERFORMED IN SUN-PRINTING UPON PATENT ALBUMENIZED PAPER.

Select a sheet of good photographic paper, free from visible defects, and make a pencil mark upon the back at one corner.

1. Pour into a flat earthenware dish some of the patent India-rubber Solution manufactured and sold by Mr. Bailey for that purpose; then immerse the sheet of paper in it, let it remain a few seconds until it has equally absorbed the solution in every part, and hang it up to dry by two corners, either pinned to the edge of a shelf or supported by wooden clips. When wetted with the solution the paper becomes semi-transparent, and looks as if it were greased,—in fact like the paper one sometimes sees under a Yorkshire pudding; but it gets dry in a few minutes, and then recovers its whiteness,

and opacity, shewing no sign whatever of the treatment it has undergone.

2. Float the face of the paper upon the surface of salted albumen contained in a shallow dish; and hang it up to dry as before. In this state the paper may be put away in a dry place, and preserved for use at any future time; or it may be coiled round a wooden roller and sent by post. Paper prepared in this way, is sold under the name of "PATENT ALBUMENIZED PAPER."

3. Excite the paper by floating it for five minutes at least upon a bath of nitrate of silver, strength 100-grs. to the oz. Hang it up to dry, as before, by clips. This operation is of course performed in a room lighted only by yellow light.

4. Expose the paper to light under a negative. This gives a positive impression true to nature in the lights and shadows, and not reversed. The light passing through the transparent parts of the negative darkens the paper beneath, while the dark parts of the negative stop the light and leave the paper white.

5. The print is now washed with water, in order to remove all the free nitrate of silver from the paper, and is then placed in the gold-toning bath. This consists of a solution of calcio-chloride of gold manufactured and sold for the purpose. It remains several minutes in this bath, until the reddish colour which it has at first becomes changed to a deep brown, bordering upon purple. It is then removed from the toning bath and washed with water.

6. It only remains now to remove the chloride of silver from the paper. This is done by immersing the print in a solution of hyposulphite of soda, or hyposulphite of lime. It is allowed to remain a few minutes in this solution, which is called the "fixing bath," and is then washed and soaked thoroughly in several changes of water; after which it is hung up to dry.

The print is now finished, and when its edges are trimmed it is ready to be mounted upon cardboard; after which it should be passed through a rolling press in order to render the surface smoother.

There are consequently SIX operations, viz:—

1. To prepare the albumenized paper.
2. To render it sensitive to light.
3. To expose it to light under a negative.
4. To tone the print.
5. To fix it.
6. To trim, mount, and roll it.

Each of these operations will be minutely described in a separate chapter; after which the theory of the process will be fully discussed.

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## CHAPTER III.

### FIRST OPERATION.—TO PREPARE THE ALBUMENIZED PAPER.

A few words first about the best kind of paper to employ. Any good clean well-made paper which

contains no deleterious chemical substance, such as "anti-chlor," may be used, and will give brilliant prints; but there will be a difference in the smoothness of the surface and the quality of the definition, according to the mode of manufacture employed. Thus, excellent prints, as regards colour and vigour, may be taken upon some kinds of common printing paper, but the surface is not so fine as may be desired. The India-rubber solution employed, according to my patent process, renders it a matter of comparative indifference how the paper is sized, but the mechanical part of its manufacture is rather an important point. At present the Rive paper, manufactured by MM. Blanchet and Kleber, appears to be the most suitable, but it is very dear, and has a blueish tint, no doubt communicated by artificial ultramarine containing sulphide of sodium, which is both inartistic, and objectionable on chemical grounds. I am in hopes that a more suitable paper may shortly be manufactured for my process by an English maker, not only at a cheaper rate, but free from the objectionable colouring matter. The paper for photographic purposes should be made when the machinery is in the cleanest possible state, and the sheets should be separately examined and sorted before being sent out to the albumenizer. The colour should be absolutely white. There does not seem to be any reason why paper which has been bleached with chlorine should have the chlorine removed when it is to be used for photographic printing purposes; and therefore the use of anti-chlor is unnecessary, to say nothing of the great objection to it on

chemical grounds. Anti-chlor is an impure kind of hyposulphite of soda, and its first bad effect is to turn the paper yellow as soon as it is excited upon the nitrate of silver bath,—the yellow colour being due to sulphide of silver. In the course of some experiments which I have made upon a sample of English paper tinted blue, I have found that the edge of the paper where the albumen has not touched the nitrate bath turns nearly black when it is put into the toning bath. Colouring matter in the paper may be objectionable, and anti-chlor is highly so, whether in the paper or in the cardboard upon which the print is mounted.

Assuming then that the Rive paper is at present the best which can be procured, the operations described in this work are founded on the supposition that this paper is used. On a future occasion I may have to modify these directions, in order to suit other paper, but that will probably not be required for some time.

Having selected a perfect sheet of Rive paper, free from holes and other visible defects, immerse it for a short time in the patent India-rubber solution sold by Mr. Bailey for the purpose; then hang it up to dry by two corners. When immersed in this solution the paper becomes semi-transparent, but it very quickly dries and recovers its white colour, without showing any trace of the operation to which it has been submitted.

The India-rubber which now fills the pores of the paper renders it much less pervious to water than it was before. This may be easily proved by immersing

a sheet of blotting paper in the solution, after which you find that you can write upon it with pen and ink, the same as upon common paper, without the ink running and blurring the letters. If water will not sink so readily into paper treated with this solution, it is evident that the albumen will not so readily sink in, but will lie more completely upon the surface and yield finer prints, having greater vigour and more warmth of colour.

This first operation of preparing the paper with the India-rubber solution is neither a very interesting nor agreeable one, and those who have tried it a few times for the purpose of experiment will most likely be glad to give it up, and buy their paper ready prepared. It must not be forgotten also that the solution is highly volatile and inflammable, and great care is consequently required in the use of it in large quantities.

The next job is to albumenize the paper. When the highest possible glaze is required, not only must no water be added to the albumen but it must either be kept some days to become thicker by evaporation, or some of the water which it naturally contains must be driven off by exposing it to a gentle heat. Salted albumen, to which no water has been added, may be kept a very long time without undergoing decomposition, but the same is not equally true of diluted albumen. Dried albumen can be obtained from France in sheets, or broken fragments of sheets, but owing to the want of care in collecting it from the eggs and separating it from the yelk, it is unsafe to use it for photographic

purposes. I believe that the red spots which so frequently occur in some samples of albumenized paper proceed either from the use of the dried albumen, or of whites of egg which have not been properly separated from yelk, germ, and particles of froth. I am led to this belief from the fact that a certain sample of albumenized paper which I had once purchased, and which gave a large number of these spots, gave none upon the back of a sheet which I had carefully albumenized myself. This, I think, proves that the red spots are traceable to the albumen and not to the paper. Dried albumen is imported by Mr. Bailey, of Wolverhampton, and can be obtained from him wholesale. It is not used in the manufacture of the patent paper.

To make the salted albumen, proceed thus. Procure fresh fowls' eggs, (or any other eggs as far as I know, gulls' eggs, for instance, which can be obtained by millions in Lundy Isle, might do just as well); break them separately upon the edge of a tea cup, and carefully rejecting the yelk and germ collect the albumen. Put all the albumen into a large vessel, and to every ounce add about 10-grs. of chloride of ammonium; then beat it up to a stiff froth. Let the liquid settle for a few hours and then beat it all up again. After it has settled a second time decant the liquid carefully, and pour it into a large flat dish in which evaporation may take place quickly. In the course of three or four days the albumen will be fit for use. If it is beaten up twice and allowed to stand for a few days it will not dry in

streaks upon the paper, and there will be no necessity to add acetic acid to it to make it limpid by dissolving the little cells in which it is contained. It must not however be used when too stale, and as soon as the smell informs you of incipient decomposition it should all be thrown away.

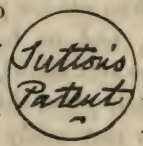
Chloride of ammonium gives a reddish colour to the albumen, but that soon disappears. Other chlorides may be used instead, and they slightly modify the colour of the print, and make it warmer, or redder. Chloride of sodium gives a beautiful madder colour, and chloride of barium a fine purple-brown. The latter salt is not deliquescent, which is an advantage if the paper is required to be kept a long time. Rather more than 10-grs. of the barium salt should be used if highly sensitive papers and very vigorous prints are required, because it contains by weight less chlorine than the other chlorides. The manufacturer of albumenized paper soon finds out by the reports sent him from the various practical men who use his paper which chloride is generally preferred, and as he cannot always be changing his formula to suit the whims of his customers, he adheres to that which gives the most general satisfaction, and the matter may safely be left in his hands. Paper prepared with 10-grs. of chloride of ammonium tones easily, and seems to be most generally liked. The albumen of course contains more salt when it becomes concentrated by evaporation.

To albumenize the paper the best side of the sheet is laid for a few seconds upon the surface of the albumen

in the flat dish, and then hung up to dry by two corners. Care must of course be taken to avoid air bubbles upon the albumen, and it ought to be filtered through muslin before use. There is some art in albumenizing properly, so as to get a fine even layer of albumen upon the paper.

When dry the albumenized papers are passed through a rolling press, which gives them a fine smooth surface. This is done chiefly for the sake of appearance, and if it were done *after* the papers are excited, instead of *before*, I think it would be better for the prints. Anyone possessing a rolling press can easily do this for himself if he likes to try the experiment.

It is in this state, viz., prepared with India-rubber solution, albumenized, and rolled, that my patent paper is sold; and it can be obtained either in small quantities, such as a quire or two, wrapped tightly round a wooden roller and sent by post open at the ends,—or in larger quantities packed flat in a deal box, and sent by rail, &c. Sample sheets can also be obtained by post. Every sheet is accompanied by a red label bearing my signature, and quires are also sealed with a label bearing the name of the manufacturer. Without these labels no paper is genuine. In the following chapters will be described the best mode of using the paper.



# CHAPTER IV.

## SECOND OPERATION. TO EXCITE THE ALBUMENIZED PAPER UPON THE NITRATE BATH.

An albumenized sheet of paper is excited, or rendered sensitive to light, by floating it upon a solution of nitrate of silver in a flat dish, made either of glass or gutta percha, and not of earthenware. The patent paper, sized with India-rubber and albumenized with undiluted albumen containing 10-grs. of chloride of ammonium to the ounce of albumen, requires a nitrate bath containing 100-grs. of nitrate of silver to the ounce of distilled water, and to be left floating upon this bath for five minutes at least.

In placing the albumenized side of the sheet of paper upon the surface of the solution of nitrate of silver be careful not to include any air bubbles, because these will produce white spots in the print.

When the paper has been floated for five minutes lift it quickly off the bath and hang it up to dry by two corners, either by means of clips, or enamelled pins stuck through the two top corners into the edge of a shelf. Then run a glass rod along the bottom edge of the paper and collect the drippings in a measure, to be afterwards added to the solution in the stock bottle. Forty drops of this solution cost a penny, so the drippings are worth saving. Some people hang up the

paper by one corner only, and stick a strip of blotting paper at the lower corner to catch the drippings; but the objection to this plan is that sometimes a *diagonal* streak is thus produced down the paper from the silver touching the pin, which is much worse than if the streak were merely formed down the *edge* of the paper, as it would be when two pins are used; besides which it is better to save the *solution* of nitrate, than to have to reduce the silver from the strips of blotting paper. When an amateur has only a few sheets of paper to excite at a time, he can be collecting the drippings from one sheet whilst another is upon the bath. When a large number of papers have to be excited it is of course a saving of time to use four nitrate baths.

After a paper has been removed from the bath, agitate the liquid before putting another paper upon it, beeause the upper part of the liquid becomes impoverished in silver by floating a salted paper upon it.

The solution should always be filtered before use; and when done with it should be put back into the stock bottle, which should contain a small quantity of kaolin, say a table spoonful to a pint of solution, which should be well shaken up with the solution and then allowed to subside again. The object of the kaolin is to prevent the bath from becoming discoloured by the albumen. Some persons use animal charcoal instead of kaolin,—and others an insoluble salt of silver, such as the citrate, or chloride. It appears that any finely-divided substance shaken up with the bath, and which does not

decompose it, will, on settling down, carry with it the colouring matter produced by the albumen. A clean colourless nitrate bath is one secret of purity in the whites of the print, and a brown discoloured bath should not be used because it communicates a tint to the paper. It is attention to these little refinements which secures first-rate prints.

The strength of the nitrate bath is a matter of great importance, and it should never be allowed to fall below 90-grs. to the ounce. The most convenient mode of testing the strength is by an ARGENTOMETER, which is allowed to float in the solution, and records the strength in grains to the ounce upon a graduated scale. This instrument can be obtained from Mr. Bailey, and the reader will find it indispensably necessary. The presence of the nitrate of ammonia or soda which accumulates in the bath by use, and affects its specific gravity, interferes of course with the theoretical accuracy of the above test, but not to the extent which might at first be supposed, and for practical purposes the Argentometer will be found to give the strength near enough.

Another important point is the time which must be allowed for the paper to float upon the bath. Some experiments have convinced me that you cannot easily err by leaving it too *long* a time, but that you *may* not get a good result if you leave it too *short* a time upon the bath. Some time ago I held a different opinion, but that I believe was wrong. I now advise five minutes as the shortest time which a paper should remain upon

a 100-gr. bath. Most photographers will have found it happen that amongst a batch of prints treated apparently in exactly the same way some are much better than others. One reason of this irregularity is a want of uniformity in the observed time of floating the papers. When only one minute is allowed, as some persons recommend, the chances are about even that you get a flat mealy print. On the other hand, I have taken a magnificent print upon a sheet of paper which was floated for one hour upon a 100-gr. bath. The idea that long floating is injurious seems therefore to be erroneous. A paper which has deeply imbibed the silver solution not only gives a fine surface picture, but has intensity and depth by transmitted light, so that the blacks of the surface print have a black background to set them off and make them still more vigorous and intense. Nevertheless it is not advisable to use a nitrate bath *stronger* than 100-grs. to the ounce.

Another mode of making the nitrate bath is as follows, and I advise the reader by all means to give it a trial; but he must be careful to follow these directions implicitly, or the experiment may end in failure :—

Make a solution of nitrate of silver containing 80-grs. of nitrate to the ounce of distilled water. Add to it liquid ammonia, a few drops at a time, stirring the liquid between each addition, until the brown precipitate of oxide of silver which is at first formed is exactly redissolved by the excess of ammonia, and the liquid

rendered clear again. Be careful not to add more ammonia than is really necessary to produce this result. The solution is now no longer one of nitrate of silver, but consists of oxide of silver dissolved in nitrate of ammonia, plus a small quantity of oxide of silver dissolved in ammonia. Add a piece of blue litmus paper to it and you will find it strongly alkaline. Also, for the sake of experiment, float a piece of albumenized paper upon it, and you will find all the albumen and chloride of silver removed from the paper and transferred to the bath, which proves that the alkaline silver solution has no power of rendering the albumen insoluble and fixing it to the paper. In this state therefore the bath is of no use, but it can be brought into proper condition by simply neutralizing its alkalinity by the addition of nitric acid. This must be added very cautiously, drop by drop, stirring between each addition, until the solution is rendered perfectly neutral both to blue and red litmus paper. Then filter it, and it is ready for use. This bath, being a little weaker in silver than the former one, offers a trifling advantage in point of economy. The papers must be floated for five minutes upon it, as before described, and they will yield very vigorous *red* prints in the pressure frame, and are rather more sensitive than the others.

The nitrate bath just described may be mixed with the former one in any proportion without producing turbidity, and the mixture will work well.

It is a curious fact that the addition of ammonia to a nitrate bath which has been already used for exciting

chloride papers does *not* throw down oxide of silver and render the solution turbid, as it does when the solution is fresh made.

Acetic acid should never be added to the nitrate bath, because it is liable to deposit crystals of acetate of silver upon the paper, which afterwards stick to the negative and ruin it.

The sensitive papers ought to be used as soon as possible after they become dry. In cold weather they may be excited one day and used the next, but in summer it is better to excite them early in the morning of the day on which they are to be used. It has been proposed to preserve excited papers in a box containing dry chloride of calcium. This certainly preserves their whiteness for a long time, but that is due to the chlorine existing in the atmosphere of the box combining with the free nitrate in the paper and producing white chloride of silver,—an effect which reduces the sensitiveness of the paper and impairs the brilliancy of the print. The best way to preserve papers in good condition for a day or two is to acidify the nitrate bath slightly with nitric acid. The papers become very quickly discoloured when the bath is alkaline; besides which the albumen is not so well fixed to the paper, and more of it is washed off into the bath.

Some American photographers have lately recommended to fume the excited paper over a dish containing ammonia, immediately before putting it into the printing frame. This is a very troublesome and disagreeable job, and without discussing its merits I shall merely

say that the finest possible prints can be got without it by the simple process which I am now describing, and I do not advise any one even to try so troublesome a modification; to say nothing of the risk one must assuredly incur of discolouring the paper by submitting it to ammoniacal fumes.

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## CHAPTER V.

### THE EXPOSURE TO LIGHT IN THE PRINTING FRAME.

As soon as the sensitive paper is dry it should be exposed to light in the printing frame. I need not describe the form or construction of this instrument, because it can be seen at any photographic depot. The amateur who confines himself to a particular size of negative should use a printing frame without a glass, made to fit the exact size of his plates, because there is then only one glass for the light to pass through, viz., that upon which the negative is taken, and the print is obtained with a shorter exposure to light. This kind of printing frame can now be obtained, made of metal, so that it does not warp in the sun. In buying a common printing frame see that the glass is not too green, because green glass greatly impedes the passage of the chemical rays. The glass of printing frames ought to be made of colourless plate. Those who have

much printing to do require a large number of printing frames in order to get through a reasonable amount of work on a dull day, by using a corresponding large number of negatives at once.

Be very careful to see that the sensitive paper is sufficiently dry when you put it into the printing frame, for if not it may stick to the negative and detach small portions of the film. The risk of this occurring is very great when an unsuitable kind of varnish is used for varnishing the negative. Until I employed a varnish made by myself, and containing no improper gum, I could never get more than twenty or thirty prints from a negative without spoiling it, unless I interposed a sheet of mica between the negative and the sensitive paper; but since I have used my own varnish I have been able to print hundreds from the same negative without accident, and without the mica. This spirit varnish is made according to a formula which I have published in my *Photographic Notes*, and it can be obtained from Mr. Bailey. It is made entirely with bleached lac, dissolved in alcohol of suitable strength and in suitable proportion, and I consider all the varnishes which I have purchased from different Firms very inferior in comparison with this. It is a most important thing to use good varnish for negatives, because the paper must not be absolutely crisp dry when laid against the negative, or you cannot get perfect contact. The risk of spoiling the negative is greatly increased when the light is dull, and the weather damp, and you have to leave the frame out for many hours.

There is also great risk when the sun is powerful and the glass of the printing frame very hot. The varnish must be able to stand great summer heat without becoming tacky, and the power of doing this is one of the excellent qualities of Mr. Bailey's varnish. To prove whether the varnish will stand this test you have only to hold a varnished negative before a hot fire, and try it with your finger. If it feels sticky the varnish is bad, and contains some of the unsuitable gums which have been recommended by various people, and which are used by manufacturers of varnish who are not photographers, and do not know exactly what is required, but go by some formula which they read in the journals. Should it be necessary to dry the paper slightly before using it, this can be conveniently done by holding a hot flat iron near it. Printing from waxed paper or calotype negatives should never be attempted except in a good light, because if the sensitive paper and the negative are left long in contact in a damp atmosphere the negative is nearly sure to be ruined with nitrate of silver spots, which cannot possibly be removed without destroying it. The great risk there is of spoiling paper negatives in printing is one of the most serious objections to taking them. The only perfectly safe plan of printing from them is by interposing a thin sheet of paper between the negative and the print, but this of course somewhat injures the definition, and greatly increases the time required for getting an impression.

Printing can be successfully performed in any daylight, (except a yellow London fog); and if the light is dull it only becomes a question of a corresponding increase in the time of printing. In strong sunshine in Jersey, the time required for a good clear negative is about ten minutes, and on a dull day in December about two hours. During one of the dullest days of the last winter, and in the midst of drizzling rain, I put out to print a clear panoramic negative, at half past ten, and covered it with a thick plate glass, which very soon became coated with water. In this state I left it, and at half past twelve, when it had been out two hours, raining all the time, I took it in and found it completely printed, and the shadows bronzed. This print turned out a remarkably good one, and was sent to London as a specimen upon my new paper. The paper was prepared and excited in exactly the way which I have described in this treatise. It is probable that in the autumn and winter some allowance must be made in England for the difference in the light between that and Jersey, but how much difference I cannot say. During my stay at King's College, from the months of February to June, in 1861, I found no difference in the actinic quality of the light between London and Jersey, either in printing or taking negatives; but on my return home from a visit to England I always fancy Jersey a particularly bright little spot after the gloom of the dear old native land. Some people affirm that actinism does not increase with the light as you approach the tropics, but that I think an improbable

assertion. It is the same sun which shines upon the whole earth,—actinism and light are propagated together,—and the nearer you go to the tropics the more perpendicular the sun's rays become and the more strongly the earth's surface is illuminated. Supposing the atmosphere to be clear and you place the printing frame so that the sun's rays fall perpendicularly upon it, what can it signify (apart from considerations of temperature) whether the place be India or Inverness? At the same instant of time the same sun is shining perpendicularly upon two pressure frames at different parts of the earth,—if then any difference is perceived in the actinic quality of the rays, that must be owing to some local atmospheric influence. The assertion that the actinic quality of the light diminishes as you approach the tropics seems to be highly improbable, because artists and travellers all agree in asserting the sky to be bluer and the stars brighter in the tropics than in higher latitudes. If then the atmosphere is clearer and not more yellow in the tropics than it is here,—if there is no appreciable difference in its chemical constitution,—and if the illuminating power of the same sun upon a surface placed at right angles to its rays is the same, as it must be, irrespective of the latitude of the place,—and if increase of temperature of a few degrees be not a retarding agent in photography, as it is not,—how unlikely it seems that the assertion should be true that actinism diminishes as you approach the tropics.

But a more important practical question than this remains to be discussed, and that is whether it is better to print in sunshine or diffused light. Strange to say difference of opinion exists on this point, even mong good authorities, and while one writer will tell you to print hard dense negatives in diffused light, another will enforce the necessity of printing them in sunshine. This difference of opinion proves that no very decided difference in result is likely to be obtained, whichever plan you adopt. Then again, some writers affirm that negatives printed in sunshine yield more permanent proofs than if printed in the shade, and that the reduced material is less acted on in the various baths. One thing is quite certain, that you can obtain a magnificent print from any good negative by sufficient exposure in a very dull light, and this proves the possibility of printing in such a light. I have found that a good negative will give a good print in a *dull light*, while a bad negative will *never* give a good print. There must be a certain vigour and intensity in the blacks of the negative, as compared with the amount of transparency in the lights, or you cannot get a first rate print. According to my experience, if you lay a sheet of paper of *any* colour through which actinic rays can pass upon the back of a good negative, and give a corresponding increase of exposure in the printing frame, you can get as good a print as if you printed under the best circumstances of light without the coloured paper. It appears to me that increase in the time of exposure makes up exactly for deficiency in the

light; and this opinion agrees with the experiments of Roscoe and Bunsen, which seem to prove that the quantity of chloride of silver reduced by light varies directly as the time of exposure multiplied by the intensity of the light. There are times when I have fancied that better prints are got from soft flat negatives in a diffused light, and from dense negatives in sunshine, but this is by no means certain, and care must be taken in adopting either this or the opposite view as certainly proved.

The print must be exposed in the printing frame until it is a little darker than you wish it to be when finished. The progress of the printing can be examined from time to time by opening the back of the frame and looking at the print, but it is not a good plan to do this oftener than is absolutely necessary, because it injures the definition. The margin of the sensitive paper which projects beyond the negative affords a good indication of the state of the print. When the sensitive paper is first taken into the light the margin turns red, and the colour darkens gradually, as the exposure proceeds, to a very rich brown, after which the darkened margin becomes bronzed, or shews a golden metallic lustre. When this occurs it is time to examine the print. If the most transparent parts of the negative are clear glass, as they ought to be, without the slightest veil of fog, the darkest parts of the print which correspond to them will be slightly bronzed, as well as the margin, and it is then time to stop the printing. This bronzed appearance of the

shadows will be removed in the toning bath, and the colour will then become a rich chesnut-black. If the other parts of the negative are sufficiently dense they will preserve the lights of the print from the over action of light, and render them of the proper relative shade; but if the negative is not sufficiently dense in the dark parts it will be impossible to carry on the printing of the shadows to the bronzed stage, and the print will be poor and flat, and have a washed out appearance, and no beauty of colour or boldness of contrast. On the other hand, if the blacks of the negative are too dense, it will be impossible to bring out the delicate gradations of shade in the high lights of the print without carrying the action of the light upon the shadows beyond the point at which they begin to be bronzed, and the bronzing will then become too deep and forcible to be removed in the toning bath. This will bury all the details in the shadows, and the print, although vigorous, will possess no harmony, and the effect will be inartistic and objectionable. Hence the importance of a good negative, in order to produce a good print. As a general rule the negatives which yield the finest prints are those which are developed with pyrogallic acid, and exhibit a creamy superficial bloom, with green solarization of the high lights, and clear glass in the shadows. Such negatives can only be produced with perfectly pure chemicals, and they are unfortunately rarely seen.

# CHAPTER VI.

## 4TH OPERATION. TO TONE THE PRINT.

The print should be toned and fixed as soon as possible after it has been removed from the printing frame.

The first thing to do is to wash as much as possible of the nitrate of silver out of the paper. This is done by soaking the print for a few minutes in clean rain water, several times changed; after which it must be immersed in the toning bath. This thorough washing of the print must not on any account be omitted, or done in a slovenly and imperfect way, because if nitrate of silver is introduced into the toning bath it decomposes it and makes it turbid, and produces mealy spots in the print. The water in which the prints are washed must be saved, in order that the silver may be collected from it, in a way which will be described bye and bye.

The best toning bath, and that which I most strongly recommend, is a solution of a double salt of gold, called CALCIO-CHLORIDE, which consists of a combination of chloride of gold with chloride of calcium, rendered slightly alkaline by an excess of chloride of lime. This solution is as limpid and colourless as water, does not become decomposed by keeping, and is always ready for use. It is manufactured for the purpose, and sold by Mr. Bailey, of Wolverhampton. No other toning bath with which I am acquainted answers nearly so well, or

combines so many important advantages; but whatever bath may act well with common albumenized paper will act equally well with the patent paper. The toning solution, as sold by Mr. Bailey in pint or half-pint bottles, is much too strong for use, and requires to be diluted with about three times its bulk of distilled water.

An old solution should not be thrown away, but strengthened with fresh from the stock bottle, as occasion may require. It is a good plan to filter it before use, but this is not absolutely necessary, because it does not become turbid when the prints are properly washed.

When the print is first immersed in the toning bath it has a disagreeable rusty-red colour, and the shadows are wanting in intensity, while the lights have rather too strong a tint. The print in this state looks flat, and is not at all pretty, and the marvellous thing is that the toning bath has at the same time the triple effect of intensifying the shadows, clearing up the lights, and removing the traces of bronzing from the over-printed parts. It is fortunate for the photographer that a chemical substance has been found which at once fulfils all these desirable conditions in a simple and effective manner.

It is interesting to watch the gradual improvement in the print which takes place in the toning bath, and observe how artistically the solution does its work. The entire change produced by toning occupies from about ten minutes to half-an-hour, according to the strength of the bath and the temperature; but slow toning is by

far the safest plan, and yields the finest prints. Several prints may be toned in the bath together, and they must be moved about frequently in the dish and not allowed to stick together. When unequal toning occurs it is generally due to not agitating the liquid in the dish so that the print is constantly covered by it. Inequalities and irregularities of any kind in this process are nearly always due to bad manipulation, which allows parts of the print to be unequally acted on by the solutions. The dishes should always be larger than the prints, so that they have room to swim about without sticking to the sides.

Leave the print in the toning bath until all the bronzing has disappeared from the shadows, the lights have cleared up, and the blacks assumed a deep chesnut tint bordering upon purple but not running into a cold blue. In this state the print looks very beautiful in colour, and extremely vigorous in the water; but the fixing bath will reduce its tone a little, while the colour will be restored by drying. Make allowance for this deepening and change of tint in drying, and do not push the toning too far. There is also risk, in over-toning, of reducing the vigour and brilliancy of the print.

Now remove the print from the toning bath, wash it in two or three changes of water, and it is ready to be fixed.

The operations of printing may all be performed in a room having only one screen of yellow calico before the

window, and there is no necessity to examine the print, whilst it is being toned, by white light, because after a very little practice you can do so just as well in the yellow light of the room. White light should not be allowed to fall upon the print during any of the operations in the dark room, because it must of necessity impair the purity of the lights. Aim at perfection, and avoid acquiring bad and slovenly habits in this process.

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## CHAPTER VII.

### 5TH OPERATION. TO FIX THE PRINT.

It now only remains to dissolve the chloride of silver out of the paper, and the print is finished. This is done by immersing the print in a small quantity of fresh solution of hyposulphite of soda, strength 1-oz. of the salt to about 6-ozs. of water. The solution ought not to have been used for the purpose before, and the print ought to be placed in a dish by itself. This is the way to secure a permanent print, but convenience is too often studied to the sacrifice of what is right, and nothing is more common than for photographers to use the same hypo for a whole day's printing, and put a large number of prints together into the same solution, without constantly moving them about in it. The possibility of adopting my advice, even on the largest

scale of printing, has been sufficiently proved by the practice of M. Blanquart-Evrard, who invariably followed this plan in his printing establishment at Lille, and it was there that I first learnt the importance of fixing every print in fresh hypo, and not allowing a number of prints to stick together in the same fixing bath.

When the print is first put into the fixing bath it loses a little of its black colour, but recovers some of it again in a few minutes. Leave it a quarter of an hour in the solution, then wash it in several changes of water, and leave it to soak a few hours in water changed two or three times, after which hang it up to dry. When dry it assumes a much blacker colour than it had in the water. The print is now finished, so far as the chemical operations are concerned.

Hyposulphite of lime may be used instead of hyposulphite of soda, and with the advantage, according to Dr. Alfred Taylor, of affording a greater chance of permanency of the proof. This salt is manufactured for photographic purposes by Mr. Bailey, and can be obtained from him in a high state of purity.

Another fixing agent, which may be used for the same purpose, is sulpho-cyanide of potassium. This salt is not poisonous, and does not sulphurate the print as the hyposulphites are liable to do, but it is of such recent introduction that I cannot speak of it with confidence. It would be at present a rather costly substitute for hyposulphite of soda, but if it is found to answer better it can no doubt be manufactured on a

large scale at a cheap rate. Mr. Bailey has taken the matter up at my suggestion, and he assures me that it can be produced tolerably cheap in large quantity if a demand for it should arise. Those who wish to give it a trial can obtain it from him. Time and experience can alone determine its merits and advantages; but it well deserves a fair trial. The sample with which I have experimented requires to be used in solution of about the same strength as hyposulphite of soda, but it need not be used fresh for every print, because it does not acquire sulphurating properties by use.

The importance of thoroughly washing the print in order to remove from the paper all traces of the fixing agent cannot be too strongly enforced, and it should be remembered that a good thorough washing at first in several changes of water is better than long soaking in water which is contaminated with hyposulphite. When several prints are put to soak together in the same vessel of water they should be roused about, and not allowed to stick together.

Another very important matter is to use pure recrystallized hyposulphite of soda which is inodorous and neutral to test paper. There is an impure sort manufactured in large quantities, near Newcastle, and sold to the paper makers under the name of "Anti-Chlor." A good deal of this acid sulphurating stuff has unfortunately got into the hands of photographers, and I would earnestly caution the reader against using it, for it will infallibly cause the fading of every print that is fixed with it.

# CHAPTER VIII.

## LAST OPERATION. TO TRIM, MOUNT, AND ROLL THE PRINT.

The print can be trimmed by laying it upon a thick sheet of plate glass, and cutting with a sharp knife against a straight edge, or glass cutting mould with bevelled edges, sold for the purpose. It is a convenient plan to fix the plate glass, upon which you cut, into a frame which turns upon a centre; these can be purchased at Mr. Solomon's Photographic Depôt.

The print can be mounted either with a warm solution of gelatine, or with a cold and rather thick solution of starch; but without proper management the cardboard "cockles" when the print gets dry, owing to its contraction in drying. To prevent this, recourse must either be had to a powerful bookbinders' press, or the cardboard must be damped with a sponge before laying the print upon it. When the print is nearly as large as the cardboard, as in the case of card portraits, or when the cardboard is very stiff, there is no fear of its "cockling." Those who mount photographs as a trade, generally use gelatine, and put the mounted picture into a powerful press, without damping the cardboard.

It is a great improvement to a mounted print to roll it between cylinders, in a press resembling that used

by copper-plate printers. Messrs. Bury Brothers, of Manchester, supply excellent machines for this purpose, of all sizes, and most of the leading photographic Firms sell "rolling presses" at a moderate price. A press has now become an indispensable requisite in every photographic establishment.

Prints are sometimes mounted upon cardboards having in the centre a space lithographed in India paper tint, so as to form a margin round the print. This is generally an improvement, and gives the photograph a more artistic appearance.

Another mode of improving sometimes the appearance of a print is to immerse it in a dye of a suitable colour. The way to do this is described in the next chapter.

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## CHAPTER IX.

### TINTING POSITIVE PRINTS.

It is a great improvement in many cases to tint a positive print with some pale colour by immersing it in a very dilute solution of a permanent dye which will not affect the silver deposit. I have experimented lately with various dyes with which Mr. Bailey has supplied me, and have selected a few which seem most suitable for this purpose. These are, Rose tint,—

Mauve,—India-tint,—Flesh colour,—Green,—and Blue. They can be obtained from Mr. Bailey in shilling bottles, with directions for use. The dye is sold in a concentrated state, and mixed with alcohol, and a few drops of it will be sufficient to add to a pint of water, which will communicate the required tint to a large number of small prints. The best way to use these dyes, or "PHOTOGRAPHIC TINTS" as they are called, is to immerse the print in the tinting bath after it has been thoroughly washed free from hypo, and before it has been dried; the colour then penetrates the paper more easily. If the print has already been dried it should be soaked in water for some time before tinting it.

Care must be taken not to make the tinting bath too strong, because although a pale delicate tint may be very beautiful, yet a strong colour cannot fail to be highly objectionable and vulgar.

Paper may be tinted with these dyes *before* it is albumenized. Also, parts of a finished print may be tinted one colour, and other parts a different colour, by means of a brush; but this must be done artistically. A cool colour should be applied to the shadows, and a warm colour to the lights.

The Photographic Tints may be mixed in any proportions, and various effects produced.

# CHAPTER X.

## THEORY OF THE PROCESS.

### 1*st.* *The Preparation of the Albumenized Paper.*

The object of the India-rubber solution is to keep the albumen more upon the surface of the paper, and not allow it to sink in. The result is a more vigorous and brilliant print, with a warmer tone. If a piece of blotting-paper is dipped into the solution of rubber and dried, you can write upon it exactly the same as upon common paper, without the letters becoming blurred.

The object of adding salt to the albumen is to produce chloride of silver in the next operation.

Albumen is contained in thin membranous cells, which are broken when the white of egg is beaten up, and the albumen liberated. These cells can be dissolved either by ammonia or acetic acid, and the addition of a few drops of either of these liquids renders the albumen more limpid. Unless the cells are properly broken up or dissolved the albumen dries in streaks upon the paper.

### 2*nd.* *The Excitation of the Paper.*

When the albumenized paper is floated upon the nitrate of silver bath, the albumen is coagulated or rendered insoluble, and a compound, which has been called "albuminate of silver," is produced. Besides

which, the chloride of ammonium in the albumen becomes decomposed, the chlorine going to the silver and the nitric acid and oxygen to the ammonium, by which chloride of silver and nitrate of ammonia are produced. If the nitrate bath is sufficiently strong, the chloride and albuminate of silver are fixed by it to the paper; but if the bath is too weak they are partly washed off the paper into the bath, and render it turbid.

The following curious experiment shews the importance of floating the albumenized side of the paper upon the silver solution. First float the back of an albumenized paper upon the solution for five minutes,—you will find the albumen coagulated by the nitrate of silver which has penetrated the paper. It might therefore be thought a good plan to excite the paper in this way first, and then turn it over and lay the albumenized side upon the bath, but experiment proves that plan to be a failure, because the print then becomes covered with small pale, white, mealy spots, and has no vigour. It is important therefore to form the albuminate and chloride of silver simultaneously, and not to form the chloride first and the albuminate afterwards.

### 3*rd*. *The Change produced by Light on the Sensitive Paper.*

When dry chloride of silver is exposed to light in vacuo no change whatever takes place in it, but if hydrogen be admitted it is immediately darkened, the chlorine leaving the silver and uniting with the hydrogen

to form hydrochloric acid, and the silver being reduced to the metallic state. Chloride of silver is not reduced by light if exposed under Nordhausen oil of vitriol in a full bottle stoppered; but as soon as the stopper is removed and the vitriol allowed to absorb atmospheric moisture, the chloride of silver is reduced by withdrawing the hydrogen from the water which is admitted. If a silver plate be exposed to the fumes of chlorine, and the film of chloride of silver thus produced upon it be exposed to sunshine in hot dry air, the discoloration produced is scarcely perceptible. When chloride of silver is exposed to light under water, and darkened, the water is afterwards found to contain hydrochloric acid, (not chlorine). If it is exposed under nitric acid, the discoloration is still produced by light, but on leaving the solution for some hours in the dark, and shaking it occasionally, the silver is redissolved by the nitric acid, and afterwards thrown down as white chloride by the hydrochloric acid which was at first generated in the solution. When moist chloride of silver is exposed to light in a saucer the surface darkens to a grey slaty tint, which, on stirring up, is found to be only superficial. If the chloride is moistened with nitrate of silver instead of water, the discoloration becomes darker and deeper, and more silver is reduced upon the surface exposed. Such are the leading facts of the decomposition of chloride of silver by light. It was at one time supposed that the result of its decomposition might be a violet sub-chloride of silver, but since the recent experiments of Mr. Malone, Mr. Spiller,

and others, that idea has been abandoned; in fact the existence of such a substance as sub-chloride of silver has not been satisfactorily proved.

When liquid albumen is dropped into a solution of nitrate of silver a white curdy precipitate of albuminate of silver is thrown down. On exposing this to light, its colour becomes slowly turned to a deep red. This red substance has not been carefully analysed by chemists, but it is supposed to consist of metallic silver diffused through the altered albumen in a state of fine division, or possibly in a state of low oxidation.

We have now to explain what happens to the mixture of chloride and albuminate of silver which is exposed to light upon the surface of a sensitive paper; bearing in mind the important fact that there is also present a large excess of free nitrate of silver, as well as atmospheric moisture within the pores of the paper.

When the chloride of silver is decomposed and hydrochloric acid produced, this acid immediately decomposes some of the free nitrate of silver and throws down fresh chloride of silver upon what has been already reduced. This is itself afterwards reduced by light, and in this way a dense dark layer of reduced silver of a violet colour is gradually produced, and nitric acid set free. But at the same time the albuminate of silver is being reduced to the red state before described, and thus the two colours, red and violet, mix and produce a violet-brown, in which the red or blue tint predominates according as the albuminate or the chloride of silver is

in excess. Whenever a sensitive paper is exposed to light, nitric acid is set free. In the dark room the sensitive paper is inodorous and neutral, but as soon as it is taken into the light it smells of nitric acid, and quickly reddens a damped blue litmus paper laid upon it.

It will be seen from the above explanation that there must be in the paper a large quantity of free nitrate of silver in order to produce vigour and depth of colour in the blackest parts of the print. When the free nitrate is washed out of a sensitive paper before exposing it to light a miserable dull print is produced. It is evident also that the paper should not be absolutely dry when exposed, because the sensitiveness of chloride of silver depends entirely upon the presence of moisture to furnish the hydrogen required for its decomposition On the other hand, when the sensitive paper is quite wet the chloride is more slowly reduced, possibly because the water retains the nitric acid, and does not allow it to escape in vapour.

Since the prints become acid by exposure to light, it follows that the water in which they are first washed must also become acid.

### *4th. The Toning Process.*

The toning bath is a double chloride of gold and calcium, with a little chloride of lime in excess, in order to counteract the effects of a trace of free nitrate left in

the paper, as well as to neutralize any acidity which may remain in the print.

If a piece of polished silver, copper, zinc, or iron be boiled in the toning solution and left in it for some time, gold is precipitated upon the baser metal, and the solution becomes converted into a double chloride of the baser metal and calcium. A solution of this kind is extensively used for gilding brass ornaments. The toning bath therefore acts by withdrawing an atom of red silver from the print and supplying its place by an atom of purple gold. An old toning bath consists for the most part of argento-chloride of calcium, and if a piece of polished iron be immersed in such a bath for a few hours a black powder is precipitated, most of which is soluble in nitric acid, and if salt be added to the solution a white powder is thrown down, which is proved to be chloride of silver. This experiment leaves no doubt whatever as to the action of the toning bath being one of substitution such as I have described.

The calcio-chloride of gold is a perfectly colourless solution, containing no free chlorine to tinge it yellow as the other toning baths do which are made with acetate or phosphate of soda; it does not therefore bleach and impoverish the print as they do, which is a great advantage.

The free nitrate of silver must be removed from the print by washing it in water before putting it into the toning bath, or it would evidently decompose that bath, and render it useless.

### *5th. The Fixing Process.*

When the print is put into a solution of pure neutral hyposulphite of soda the chloride of silver which the paper still contains is dissolved out; the results of the decomposition being, chloride of sodium, and a soluble double hyposulphite of silver and soda composed of *one* equivalent of hyposulphite of silver and *two* equivalents of hyposulphite of soda. This double salt is extremely soluble in water and has a sweet taste. It is stable under the action of light and air, and can be obtained in fine crystals. If the hypo bath is too weak a double hyposulphite of silver and soda is formed which contains only *one* equivalent of hyposulphite of soda. This double salt is unstable, and is decomposed by exposure to light, and also by diluting its solution with too much water. The result of its decomposition is ultimately sulphide of silver, which fills the pores of the paper, besides shewing its baneful presence upon the surface, and producing what photographers have called "measles."

It has been observed that prints upon albumenized paper never entirely lose a trace of silver, which is rendered evident by dropping upon the whitest part of the print a small quantity of dilute sulphide of ammonium, which produces a brown stain. The probability is that the albumen retains with much obstinacy a trace of the last chemical in which the paper was immersed, viz., the double hyposulphite of silver and soda; but as this is a stable salt it does not seem to affect the permanency of the print, under ordinary circumstances of exposure.

If the hyposulphite solution possesses sulphurating properties the trace which is left in the paper will be very likely to destroy the print by persulphurating it to the yellow stage.

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## CHAPTER XI.

### TREATMENT OF SILVER RESIDUES.

Although it is necessary, in order to get vigorous prints, to use a very strong nitrate bath and float the paper for five minutes upon it, yet a small portion only of the silver solution which the paper imbibes is really reduced in the shadows of the print, and at least nine-tenths of it are soaked out of the paper before putting the print into the toning bath. It becomes important therefore to save this silver and not let it go down the sink.

There are two ways of treating the water in which prints have been washed prior to toning them. One method consists in adding salt to the water, and precipitating the silver in the form of white chloride, which can be collected and reduced. The other plan consists in adding bicarbonate of soda to the water, and precipitating yellow carbonate of silver, which can be collected and made again into nitrate of silver by simply adding nitric acid to it.

The best plan for the photographer to pursue with his chloride of silver is to send it to Mr. Bailey, who will give a fair quantity of nitrate of silver in exchange. But if he likes to reduce it himself he can do so by first drying it, and then putting it into a crucible with about twice the quantity of soda, and fusing it in a fierce fire urged by bellows. A button of pure metallic silver will be formed at the bottom of the crucible.

To convert carbonate of silver into nitrate it is only necessary to add nitric acid, which will dissolve it with effervescence,—and then crystallize the salt from the solution. Be careful not to add too much nitric acid, but always leave a little of the carbonate undissolved.

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## CHAPTER XII.

### CAUSES OF FAILURE.

Although failures are not likely to occur when the directions given in this work are strictly followed, yet the work would be incomplete were I not to conclude with a few words upon some of the chief causes of failure when the manipulation is improperly performed.

Unless the albumen is well beaten up it dries in streaks down the paper.

If you add too much salt to the albumen in proportion to the strength of the nitrate bath, or the time of floating

the paper upon it, you will find insensitive patches upon the print where the light has only darkened the shadows to a pale grey tint.

If you use a nitrate bath weaker than 80-grs. to the oz., and float the paper for less than five minutes upon it, the chances are that you will get a flat dull print. Vigour is got by using undiluted albumen and a 100-gr. nitrate bath, and by long floating upon it.

Unless you wash the print well before putting it into the toning bath, you will render the toning bath turbid and throw down the gold.

If in washing the print you leave it too long with its face upwards in water which has been rendered turbid with chloride of silver, a white precipitate will settle upon the print and stick to it, and this will interfere with the action of the toning bath in those places where it occurs.

Over-toning produces mealy prints of a cold dull appearance, as well as small dull spots in the albumen. This failure is less likely to occur with the calcio-chloride toning bath than with the acetate and phosphate baths. The richest prints are those which are only toned to a deep red, or chesnut-black.

A too weak hypo bath produces an insoluble precipitate of sulphide of silver within the pores of the paper, as well as a spotted measly appearance of the surface.

If the hyposulphite of soda is acid, and smells of sulphur, the prints will be nearly sure to fade. This

will also happen if they are not quickly and thoroughly washed free from traces of the hyposulphite after being fixed.

If you handle a print when it is in the washing water before being toned, with fingers which savour of hypo, it will produce indelible brown stains upon the print.

The cardboard upon which a print is mounted should not contain anti-chlor, or that will cause the print to fade.

Mounting a print with sour paste or acid gum will cause it to fade.

THE END

## INSTRUCTIONS

*For Using the various Preparations Manufactured by Mr. Bailey*

The Collodions are all made with the finest Pyroxyline, and the purest Ether and Alcohol redistilled with lime, and they are brilliantly clear and free from sediment. The other preparations are also in the highest state of purity, and are particularly recommended as the best of their kind for their respective uses. For further information consult Mr. Sutton's new work on the "Collodion Processes, Wet and Dry."

### COLLODIONS.

BROMO-IODIZED COLLODION for card portraits and stereo views. This collodion gives a very creamy, even film, is highly sensitive, and does not solarize. No after-intensifying is required when a pure nitrate bath is used. Develop with 30-grs. of protosulphate of iron, and 30-mins. of acetic acid to the oz. of water. The developer may be kept upon the plate as long as a pyro developer without fogging the lights.

CADMIUM COLLODION, ready iodized. This is to be used with a pyro developer, and gives red creamy blooming negatives of extraordinary brilliancy. It will not work at first with a pure neutral nitrate bath, and it is necessary to add to it at first some yellow ammonium iodized collodion in order to prevent fog. The developer consists of pyrogallic acid 1-gr., acetic acid 1-scr., water 1-oz.

PLAIN COLLODION, with ammonium iodizer separate. Add one part of the iodizer to three parts of plain collodion, and use it the next day, with a pyro developer. This collodion loses its sensitiveness by keeping. It is very useful to add it to other collodions, in order to produce various effects; and when old and dark coloured it is suitable for copying maps in which dense blacks and clean lights are required.

RAPID DRY COLLODION. This collodion is extra bromized and contains an equal number of atoms of iodine and bromine. It gives an even delicate film, and is suitable for all the Dry processes, except Collodio-albumen.

The purchaser should obtain an equal quantity of all the above collodions, in order that he may mix them so as to obtain any required effect. He should also procure some pure absolute ether and alcohol, in order to supply loss from evaporation.

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PURE NITRATE OF SILVER, in glass tubes. This salt is trebly recrystallized, and rendered perfectly neutral to test paper. It is intended for the negative nitrate bath, strength 30 to 40-grs. to the oz. of water. Never doctor the bath in any way, but at first leave an iodized plate in it all night to charge it with iodide of silver. When it gets old, first add to it an equal quantity of water which will make it turbid, then filter, and afterwards add the necessary quantity of nitrate of silver. Always filter a fresh solution before use, otherwise it will produce comets and streaks.

KEROSOLENE COATING FLUID. This is intended to prevent splitting and blistering of the film in the Dry processes. Coat the plate with it the same as with collodion. It gives a clear film, which will dry in a minute or two; then pour on the collodion, and proceed as usual.

INTENSIFIER FOR NEGATIVES. This is much better than a mixture of pyro and silver, because it may be used in daylight and does not become turbid. It is a clear strong solution of iodide of mercury. The negative must be well washed before it is applied. Dilute it according to circumstances. Do not push the intensification to the yellow stage.

SUPERFINE SPIRIT VARNISH. This varnish gives a film which is as clear and hard as glass, and never becomes tacky. It affords the best possible protection to the negative and does not reduce its density. The plate must be slightly warmed before and after applying the varnish.

CALCIO-CHLORIDE OF GOLD. This is the very best toning bath for albumenized positive prints, and is strongly recommended to be used with Mr. Sutton's patent paper. It is quite permanent in solution, and always ready for use. See directions.

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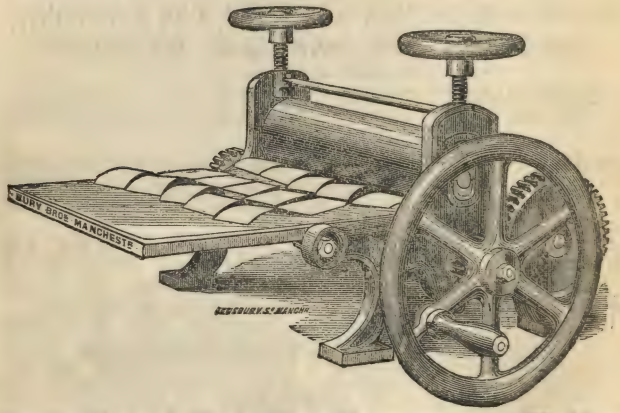


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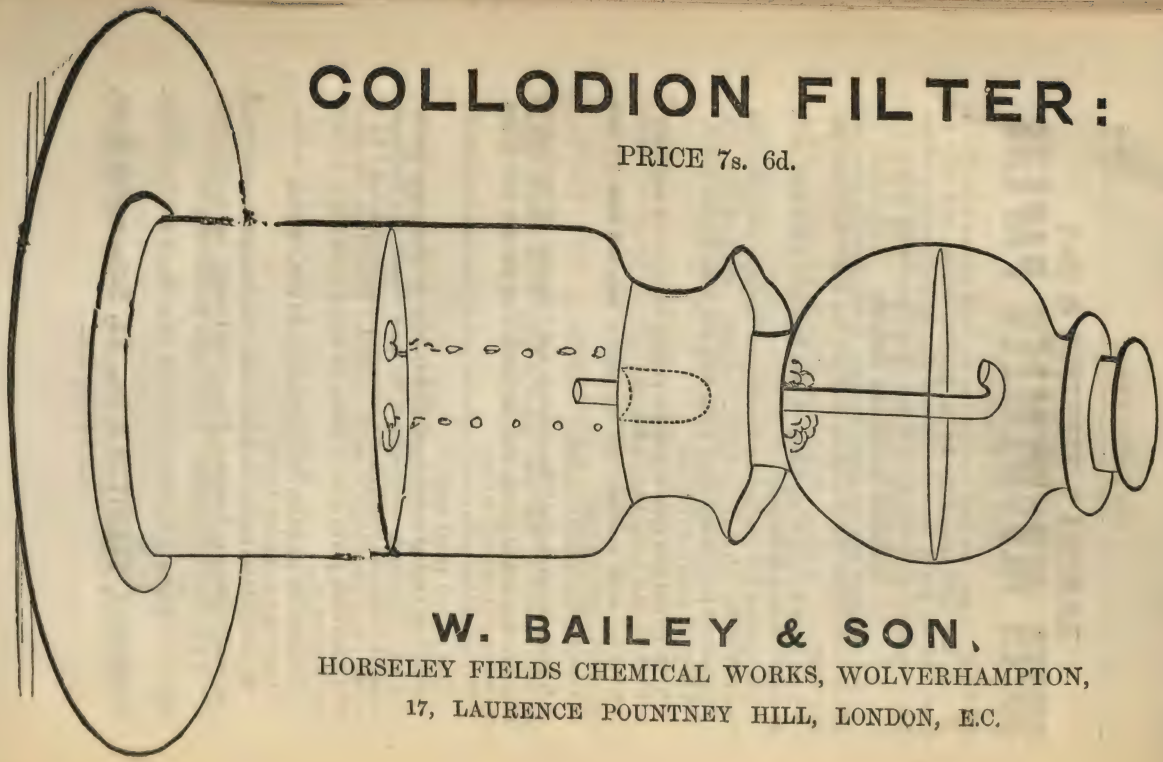

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